ISSUES IN PROGRAMMING FOR MATERNAL ANEMIA

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MotherCare

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Abbreviations and Acronyms

BMI	Body Mass Index
CA	Cooperating Agency (USAID)
CHC	Community Health Center
DHS	Demographic and Health Survey
DOT	Directly observed therapy
FP	Family planning
Hgb/Hb	Hemoglobin
HIV	Human Immunodeficiency Virus
IDA	Iron Deficiency Anemia
IEC	Information, Education and Communication
IFA	Iron/Folic Acid
INACG	International Nutritional Anemia Consultative Group
IPCC	Interpersonal Communication and Counseling
JSI	John Snow, Incorporated
MCH	Maternal and Child Health
MI	Micronutrient Initiative
MMR	Maternal Mortality Ratio
MOH	Ministry of Health
MORA	Ministry of Religious Affairs (Indonesia)
NGO	Non-governmental organization
NHANES	National Health and Nutrition Examination Survey
OB	Obstetrics
OR	Operations research
POT	Personally observed therapy
PVO	Private voluntary organization
RA	Religious Affairs (Indonesia)
RH	Reproductive health
SF	Serum Ferritin
SP	Sulfadoxine/pyrimethamine
SWACH	Survival for Women and Children Foundation (India)
TBA	Traditional Birth Attendant
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

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Introduction

In many settings, women face barriers to optimal nutrition at every stage in their lives. Adverse economic, sociocultural, geographic, and political conditions can create immense obstacles to adequate protein/energy and micronutrient status for these women, beginning in utero and continuing through infancy, childhood, adolescence, and adulthood. Nutritional deficiencies pose threats to optimal growth, development, and overall productive functioning at every age.

The MotherCare Project addressed health problems related to pregnancy, safe labor and delivery of a healthy baby, and the early postpartum period, with an emphasis on improving the quality of health care services for women. Maternal nutrition was an important component of the integrated services for pregnant women that comprised this health strategy. Failure to access health services is one of the major constraints to better health and nutrition for women, but pregnancy is frequently one of the few times in their lives that this connection takes place, making interventions for both maternal and infant nutrition feasible.

There is consensus on a number of evidence-based strategies and interventions to significantly improve the nutrition status of both mother and fetus/infant. They have potential for delivery to pregnant and postpartum women through existing public health systems (see Appendix, Table A1), and there is growing operational experience with their implementation. From among these basic nutrition services, the MotherCare project focused on the prevention and control of maternal anemia through a strategy of supplementation of pregnant women with iron/folate.

Research under MotherCare I (1989-1993) sought to answer questions about ways to improve existing iron supplementation programs for pregnant women in Indonesia. Building on experience with IEC campaigns to inform women about the importance of iron, community-based supplement distribution schemes, and improved health worker counseling, MotherCare II (1993-1998) incorporated iron supplementation programs in its three long-term country projects (Bolivia, Guatemala, and Indonesia). In addition, applied research in India, Malawi, Peru, and Indonesia continued to generate innovative approaches to improved effectiveness of iron supplementation strategies.

Based on the MotherCare project experience of the past decade, this booklet reflects on the results of a number of approaches for strengthening iron supplementation programs within integrated maternal health services. It provides a rationale for the need to implement careful assessment of each setting in which iron deficiency and anemia are problems, and offers guidance for strategies that may help to enhance and sustain efforts to improve the iron status of women at multiple stages in their lives.

Issues in programming for maternal anemia

1. Maternal health/safe motherhood programs are frequently unable to deliver the full range of nutrition services that would be considered ideal. Therefore, where should scarce resources be targeted?

Few would argue that adequate nutrition during pregnancy—appropriate amounts of protein, energy, and micronutrients for the support of both maternal and fetal health, growth, and development needs—is crucial. But operational and economic constraints may dictate prioritization of nutrition services. Globally, among all population groups, iron deficiency (and its severe manifestation as anemia) is the single most prevalent nutrient deficiency condition. Current estimates from the World Health Organization (WHO) (2000) put anemia prevalence at 52% among pregnant women, with the highest prevalence rate (76%) found among pregnant women in South Asia. The magnitude of the problem combined with its negative consequences for both mother and infant justify its prioritization within maternal health programs.

Figure 1 illustrates the possible consequences of iron deficiency and anemia in mothers and their offspring[1].

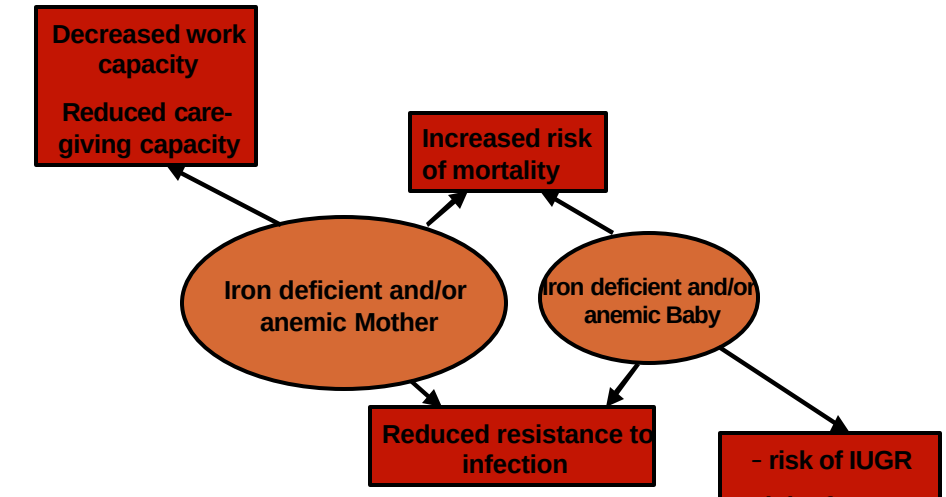


Figure 1: Potential consequences of iron deficiency and/or anemia for mother and infant

Up to 90% of maternal anemia results from inadequate intake of bioavailable dietary iron. Depending on local conditions, other determinants can also play a key role: increased blood loss due to hookworm or schistosomiasis; the impact of chronic infections such as malaria and HIV/AIDS; folic acid and B_{12} deficiencies; and genetic disorders such as sickle cell anemia and thalassemia major.

Even in highly developed countries, dietary iron sources are rarely sufficient to meet the elevated physiological iron demands of pregnancy. **Therefore, supplementation with iron folate (IFA) for pregnant women is a key intervention strategy.** Other approaches to the problem include efforts to modify the diet, fortify staple foods with iron, treat helminth and other infections, promote child spacing, and target non-pregnant women and adolescent girls for improved iron nutriture.

2. What are reasonable goals for treating and/or preventing anemia among pregnant women?

The International Nutritional Anemia Consultative Group (INACG), the World Health Organization (WHO), and the United Nations Children's Fund (UNICEF) have endorsed guidelines recommending that:

- All women should receive and consume daily iron folate supplements for at least 6 months during pregnancy.

- Where anemia prevalence is <40%, women should receive supplements containing 60 mg iron and 400 μg folic acid for the 6-month duration (continuing into the postpartum period if needed to achieve the full 6-month dosage).

- In areas where anemia prevalence is high among pregnant women ($\geq$ 40%), women should continue the same dose for an additional 3 months in the postpartum period (for a total of 9 months) (Stoltzfus and Dreyfuss, 1998).

3. Large-scale iron supplementation programs for pregnant women always fail – women will not comply with this strategy because of side effects, so why bother with this approach?

Traditional explanations of supplementation program failure often focus on women's non-compliance with iron/folate tablet consumption. Yet careful analysis of supply system studies and formative research looking at the quality of health service delivery shows that the main determinants of programmatic failure are a complex of factors often largely beyond the control of women and their families (MotherCare country reports, 1992-1997; Galloway and McGuire, 1994). Formative research (see Box 1) helped to identify a range of constraints and enablers to iron supplementation programs.

- Without an adequate supply of iron/folate tablets at the national and regional levels, iron supplementation programs cannot achieve success.

- Distribution systems (both public and private sector) must be developed to insure that women can easily access the supplements free of charge or at a reasonably low cost close to their homes.

- Health care personnel must be convinced of the importance of iron to pregnant women – it has to become a health service priority for antenatal care which continues to receive emphasis well into the post-partum period – and they have to be trained to deliver the supplements and counseling appropriately.

Box 1: Voices of women and health service providers: Constraints and enablers to iron supplementation program success (MotherCare 1995-1998)

Economic barriers*:* "Vitamins increase the appetite; if we don't have anything to eat, why would we want to become more hungry?" (Woman, Honduras)
Normalcy of anemia*:* "Dizziness and feeling tired are normal during pregnancy." "Pregnant women have always felt these things." (Woman, Indonesia)
Problematic supply*:* "We cannot depend on iron forever; the time will come when it won't be available and if they get addicted to this thing [it will be a problem]." (Medical officer, Malawi)
Side effects*:* "I don't like it because my feces turn black. I'm afraid my blood will also turn black." (Woman, Indonesia)
"I don't take iron pills to avoid a big baby and suffering at delivery." (Woman, Honduras)
Inadequate counseling*:* "They just gave the tablets; they didn't give any instructions." (Woman, India)
Women are the problem*:* "Yes, anemia is an important problem, but if women would just eat properly, they wouldn't become anemic. There isn't much anemia in this community, and we are giving all of them iron tablets. But they only help if the women take them correctly. Even the anemic women don't take the tablets when they're told to." (Junior health assistant, India)
"It is the pregnant woman who needs the iron. It should be her responsibility to come and get it." (TBA, Indonesia)
Improved wellbeing*:* "[Because of the iron tablets everyday I feel better, I feel like doing everything. Now I am eating better and I have gained a little weight." (Woman, Bolivia)
Tablet characteristics*:* "The medicine has the smell of blood but that didn't worry me because they are helpful and good." (Woman, Malawi)
"I think, we don't have anemia so why take the tablets?" This taste stays stuck to your mouth; it's bitter; it tastes like blood." (Woman, Bolivia)
Forgetfulness*:* "If I take it while eating, I remember, but sometimes after eating I must return to work quickly, so I forget." (Woman, Indonesia)
Suspicious of government services "They think that probably [the IFA tablets] are not what we give them or maybe that we do harm to the baby and they are afraid they can't have children." (Government health worker, Guatemala)
"We prefer to go to a private doctor and buy tablets. These government tablets are free of cost and that's why it doesn't suit us." (Woman, India)

Some pregnant women do experience a range of minor gastrointestinal side effects when they consume iron/folate supplements. But as recent MotherCare-supported TIPs (Trials of Improved Practices) with iron in several countries have demonstrated, the majority of women will persist with a daily supplementation regimen when they:

- are taught methods to counteract the side effects,
- understand the highly desirable health benefits for themselves and their infants,
- experience relief from the characteristic exhaustion, headaches, and other negative symptoms of anemia, and
- can obtain high-quality iron/folate tablets easily and consistently during their pregnancy.

4. What types of program strategies have shown success with using iron/folate supplementation to prevent and control iron deficiency and anemia in pregnant women?

Programs that have proved successful with using iron/folate supplementation to prevent and control iron deficiency and anemia in pregnant women have focused on (1) increasing availability of supplements, (2) increasing acceptability of iron/folate tablets, (3) improving provider performance, (4) increasing compliance, and (5) encouraging iron supplementation earlier in life.

(a) <u>Increasing availability</u>

- **Expand community-based services and sources of supplements**

Rationale: Lack of access to health services for women and a reluctance to utilize services even when they are available are frequent contributors to the poor track records of existing iron supplementation programs in many settings. In most MotherCare project sites, programs expanded the numbers of local, community-based providers able to deliver anemia counseling and education services and iron folate supplements to women.

Example: Traditional birth attendants (TBAs) can be an effective channel for distributing iron supplements. In Maluku, Indonesia, Project Concern International verified this finding, based on the success of an earlier MotherCare project in West Java (Utomo, B. et al, 1993). Women receiving their tablets and information on a weekly basis from trained TBAs consumed an average of 30 tablets more (or an additional 1800 mg elemental iron during their pregnancy) than the control group who received regular services from their health center. Compliance was higher among the TBA-served group, and as Figure 2 illustrates, they experienced a net rise versus a net decrease in hemoglobin (Robinson, 1998).

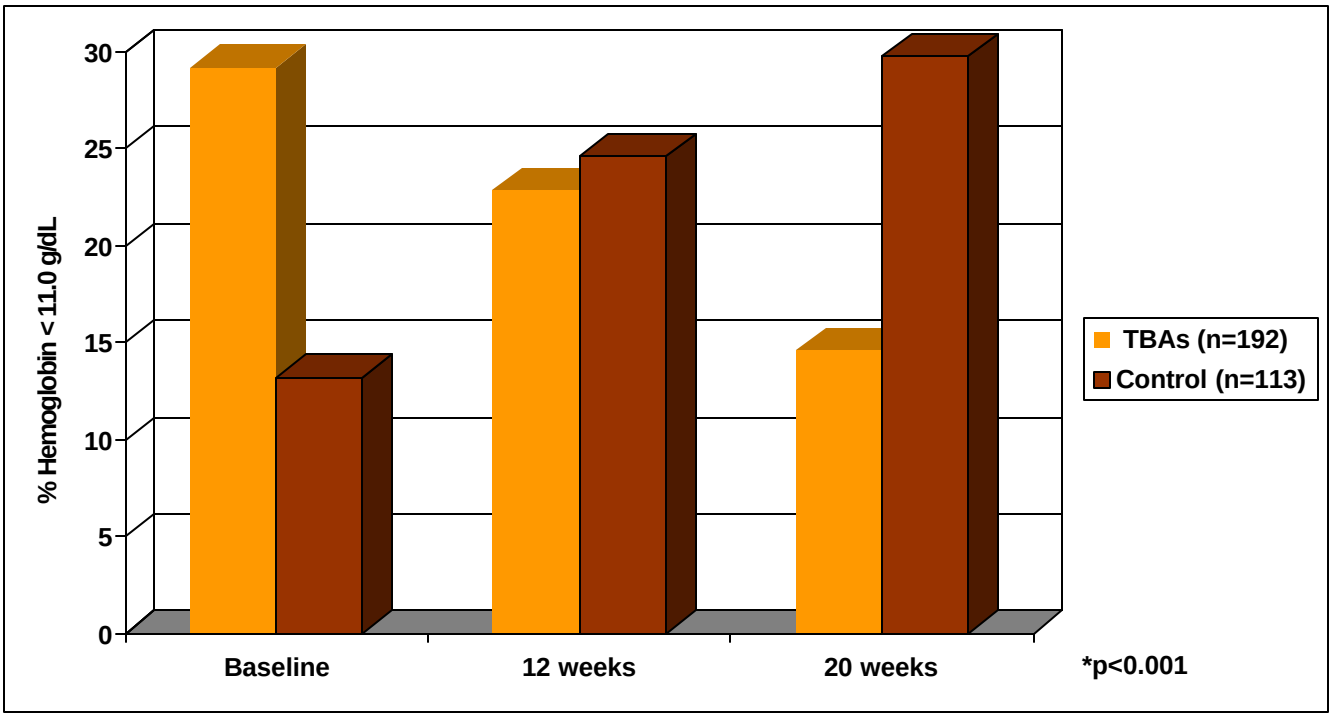


Figure 2: Comparison of anemia prevalence levels among TBA and Control Group IFA tablet delivery systems
(Robinson,1998)

(b) <u>Increasing acceptability</u>

- **Base targeted IEC messages and innovative dissemination strategies on formative research**

Rationale: Qualitative research can identify the unique barriers and facilitating conditions to iron supplement consumption in a community. Delivery channels for communications and the content of messages will be better targeted if the formative research phase has been implemented and results analyzed and fed into the Information, Education, and Communication (IEC) strategy.

Example: Results of formative research in MotherCare/Indonesia's project area identified a lack of household-level understanding about: 1) the causes of anemia, 2) the potential impact on pregnancy outcomes, and 3) the importance of iron supplements to correct or prevent maternal anemia (as well as the misperception of iron consumption contributing to high blood pressure). The community's concept of health as being free from "active" illness was also a barrier to preventive health/nutrition behavior. A local religious leader was identified as a highly influential voice in the community. He agreed to participate in the project, and his image was used in print materials encouraging pregnant women to take iron tablets. This same concept of validating the message by virtue of the messenger was used for messages about iron for new brides. The

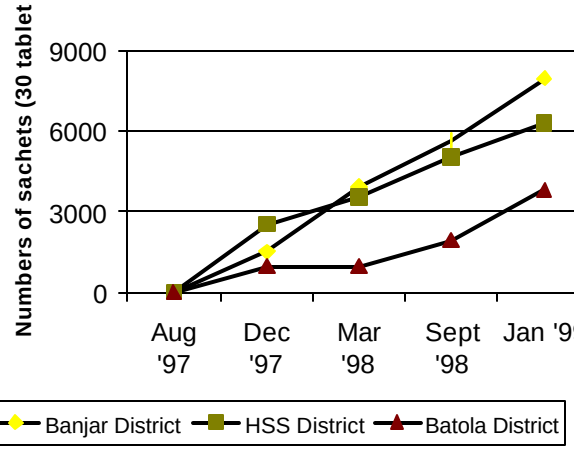
target audience selected a glamorous young woman pictured in elaborate wedding attire as the best spokesperson.

- **Improve quality and marketing of IFA supplements**

Rationale: Results from qualitative research in eight countries consistently highlighted the importance of the type, packaging, and presentation of IFA supplements for women (Galloway, et al, submitted, 2000). Unappealing taste, color, and texture are cited as reasons for not purchasing or consuming iron. A tendency for tablets to disintegrate in hot, moist climates means that protective (but low-cost) packaging must be designed to preserve them. The private sector is well equipped to work with the public sector to develop, produce, and distribute iron supplements to community-based retail outlets for easy access by women and their families.

Example: In Indonesia, MotherCare and the Ministry of Health partnered with three pharmaceutical companies to develop low-cost, specially packaged sachets of 30 iron tablets in order to meet an increased demand for iron supplements. Bright banners and informational pamphlets were designed to help small retail shop owners advertise their ability to supply iron and deliver basic information about them to clients. An additional private sector strategy was developed with the village midwives, the main health service providers to pregnant women. They now purchase sachets of iron and sell them for a small profit to their clients who do not qualify for the government-supplied free iron tablets. According to evaluation results, women prefer this supply route to that of the small shops. Comparison of pregnant women surveyed in the baseline (1996) and post-survey (1999) assessments in South Kalimantan found that 20 percent of iron consumed in 1999 was purchased, whereas no iron was purchased prior to the start of the program in 1996. In Figure 3, cumulative iron tablet sales during the period from August 1997 to January 1999 document steady or increasing purchase of iron, despite the intervening economic crisis in the country.

Figure 3: Cummulative iron sachet sales by village midwives (MotherCare districts)



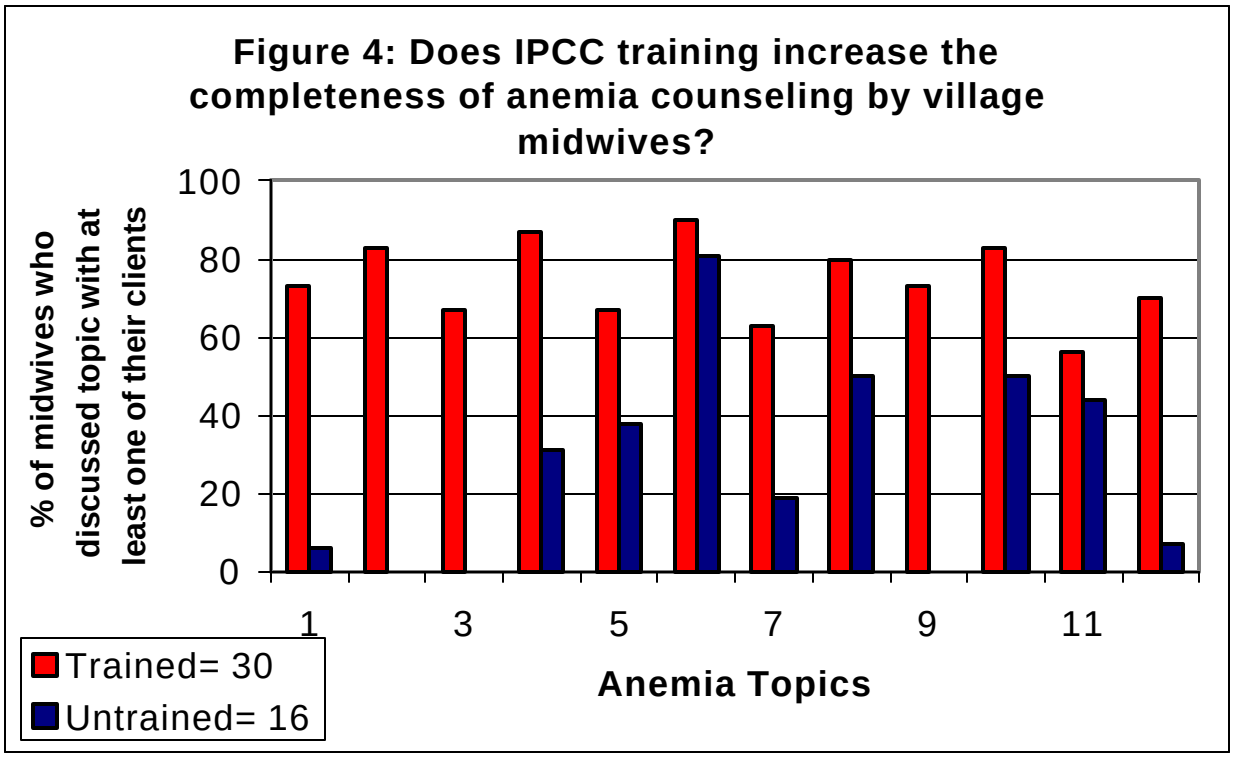
Zizic, 1999

(c) <u>Improving provider performance</u>

- **Train service providers in maternal anemia prevention/management counseling and IFA supplement distribution skills**

Rationale: MotherCare's research and program experience underscores the critical importance of the ***provider*** for the success of iron supplementation programs. Lack of knowledge about the importance of controlling iron deficiency and anemia during pregnancy contributes to the frequent disinterest and low priority placed on delivery of IFA supplements to women. Providers must be willing (and trained) to actively engage in education and counseling of clients in order to motivate and support women in adhering to the daily regimen. From a range of countries (India, Bolivia, Malawi, Guatemala) comes evidence that there are often serious misperceptions on the part of service providers regarding women's reasons for non-adherence to the long-term supplementation schedule during pregnancy and the postpartum periods. Unless they can communicate the importance of iron to the mothers and their babies and enable women to surmount logistical, behavioral, cultural, and physical (e.g., side effects) barriers, programs will not succeed.

Example: MotherCare/Indonesia designed and implemented a training course in Interpersonal Counseling and Communications (IPCC) to reduce communications barriers between village midwives (the Government of Indonesia's primary provider of maternal health services) and the communities in which they live and work. The substantive focus of the training course was anemia. Evaluation results show that trained midwives provided significantly enhanced, more complete counseling and information to women about anemia (Zazri et al, 2000). Direct observation of midwives found that over 55 percent of the IPCC-trained midwives discussed 100 percent of the anemia topics, while untrained providers neglected discussion of 3 of the 12 topics completely (Figure 4). Trained midwives were reported by clients to discuss management of supplement side effects with significantly ($p<0.001$) higher frequency (59 percent of trained versus 15 percent of untrained). A concrete benefit of the enhanced provider skills was raised confidence in the provider's advice related to anemia. During exit interviews, 98 percent of respondents served by trained personnel stated they would follow the midwife's advice on anemia as compared to 32 percent of women receiving services from non-IPCC-trained midwives ($p<0.001$).



Anemia Topics:

1. explains what anemia is
2. explains the effects of anemia on mother
3. explains the effects of anemia on baby
4. explains benefits of iron pills
5. explains side effects
6. suggests taking iron in the evening
7. suggests taking iron with fruit
8. suggests taking iron w/o coffee or tea
9. suggests taking iron after meals
10. suggests taking 1 pill/ day during pregnancy
11. suggests taking 1 pill/ day post-partum
12. suggests where to buy iron pills

(d) <u>Increasing compliance</u>

- **Develop specific tools and approaches to address the difficulties of a daily regimen**

Rationale: Similar to most of its project sites, MotherCare-funded research in India demonstrated that forgetfulness is a significant barrier to daily compliance with iron supplements. In Baroda, Gujarat, nearly 50 percent of women participating in in-depth interviews felt that they needed outside assistance to remember to consume IFA tablets.

Examples: Reminder calendars were developed in Bolivia and Indonesia for women to use in their homes. They provided space for storage of IFA tablets, spots for marking that a tablet had been consumed that day, and pictorial/written information about anemia prevention. The St. John's Medical College (Bangalore, India) anemia project experimented with distributing red bangles and bindis to women. The red color symbolizes healthy, non-anemic blood, and the use of jingling ornaments reminds the women to take their iron supplements on a daily basis.

Under a MotherCare-supported project in Haryana, India, the Survival for Women and Children Foundation (SWACH) adapted the directly observed therapy (DOT) strategy used in tuberculosis treatment programs. The project implemented POT, or personally observed treatment, as a mechanism to combat the difficulties of a daily iron regimen. Adolescent girls on their way to and from school stopped by the homes of pregnant women who had been diagnosed with moderate anemia. They supervised the consumption of twice-daily iron supplements and provided information about iron and anemia. With this treatment strategy, they were able to achieve nearly 100% compliance.

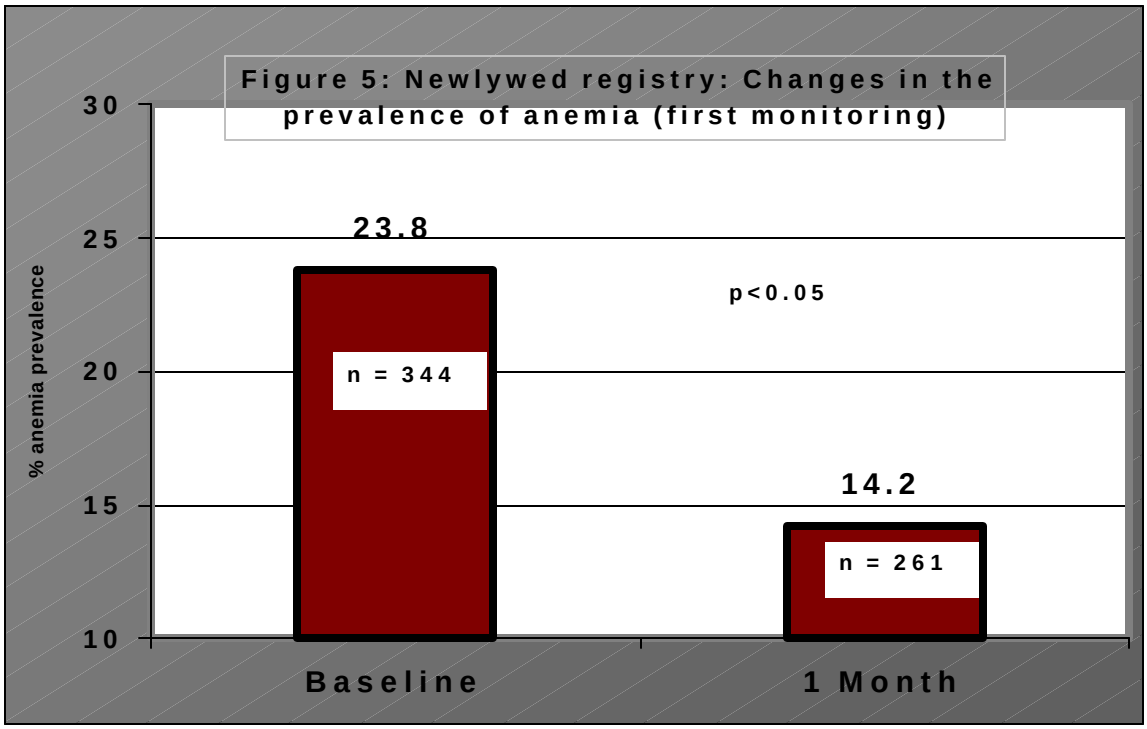
(e) Starting earlier in life

- **Expand the target population to include non-pregnant women and adolescent girls**

Rationale: Focusing on pregnancy as a time to prevent or treat iron deficiency and anemia is critical for addressing the negative impact of this type of malnutrition on both mother and baby. It is also frequently one of the few opportunities for health services to have contact with women. But women often enter pregnancy with compromised iron status, having developed iron deficiency earlier in life. Adolescent girls are particularly vulnerable to this because of the combined iron demands of growth and menstruation. At the same time, this age group has been shown to be highly amenable to behavior change messages about diet and supplementation for improved iron status. In contrast, women may be more affected than non-pregnant adolescent girls by culture-based food taboos and concerns about ingesting “medications” (i.e., iron supplements) while pregnant.

Example: In Indonesia, a groundbreaking partnership between the Ministry of Health and the Ministry of Religious Affairs (MORA) has focused on a new program aimed at women prior to their first pregnancy. MotherCare and the MOH trained religious affairs (RA) officers to counsel couples undergoing mandatory registry for marriage. The main message delivered by the RA staff is for brides to purchase and take daily iron tablets for at least 30 days prior to conception. Village midwives reinforce the messages and can sell tablets to the couples.

The results of the pilot study of nearly 300 women are encouraging (Figure 5), with a 40% reduction in the prevalence of anemia (from 23.8% to 14. 2%) and an average of 26 tablets consumed over the month.



(Jus'at et al, 2000)

5. Why is maternal nutrition behavior change for consumption of iron supplementation so difficult to achieve?

At first glance, the problem and its solution appear relatively simple. During pregnancy (and possibly during the postpartum period), women in most settings need to consume one iron/folate tablet each day. Relative to the difficult behavioral aspects of addressing the rare event of a complication or obstetric emergency during the antenatal or intrapartum periods, taking iron tablets should be a straightforward, even mundane, behavior to communicate and support. Yet India (as an example), with its decades-old national policy for provision of iron supplements to pregnant women, and its concurrent failure to reduce the nation's high levels of maternal anemia, underscores the complexity of the multi-system determinants and behavioral issues of successful prevention and control of the condition.

Traditionally, distribution of iron supplements and dissemination of dietary advice have been key functions of health care service providers during antenatal care visits by women to health facilities. In this scenario, there is a range of important behaviors involving access of the services, household-based action by women and their families, and the complex of behaviors required of the service provider.

For the client, behaviors include the:

- Access of prenatal health services (sources of services vary and include TBAs, village midwives, health posts, hospitals, and clinics)
- Receipt of information/services/materials regarding iron deficiency, anemia, iron supplementation
- Procurement of iron/folate tablets from 1) public sector health services, or 2) private sector sources
- Daily consumption of iron/folate tablets, beginning as early as possible in pregnancy, for a minimum of 90 days

- Use of reminder materials (e.g., daily marking of a reminder calendar)
- Recognition of side effects due to iron supplement consumption
- Action to mitigate side effects
- Dietary intake changes including increased consumption of bioavailable sources of iron and iron absorption enhancers; reduced consumption of iron absorption inhibitors with meals; purchase and consumption of iron fortified foods

For health workers, there is also a series of crucial behaviors or actions that must be implemented effectively to achieve programmatic success:

- Receipt and synthesis of accurate information regarding maternal anemia prevention and control
- Appropriate use of anemia education materials (e.g., flipcharts, films, feltboards, etc.)
- Ability to effectively communicate information to clients and their families regarding:
  - priority of anemia control
  - recognition of the condition
  - methods to treat and prevent
  - recognition/management of side effects from iron/folate tablets
  - dietary interventions for improved iron status
  - rationale for consumption of iron fortified foods
  - supplement storage issues
  - child safety protocols with supplements
  - recommended total dosage of iron over the pregnancy
  - sources of iron supplements if not available in adequate amounts through the public health system

The larger environmental determinants of the desired behavior (taking iron supplements) encompass the range of complex variables within the supply and distribution system for the iron/folate tablets. These include the interest and support (financial, political, administrative) of maternal/child anemia prevention/control strategies at all levels of political structure(s), a steady supply of high quality iron/folate supplements to the public sector health system, and a well-functioning distribution system for movement of IFA tablets from central supply sites to the periphery.

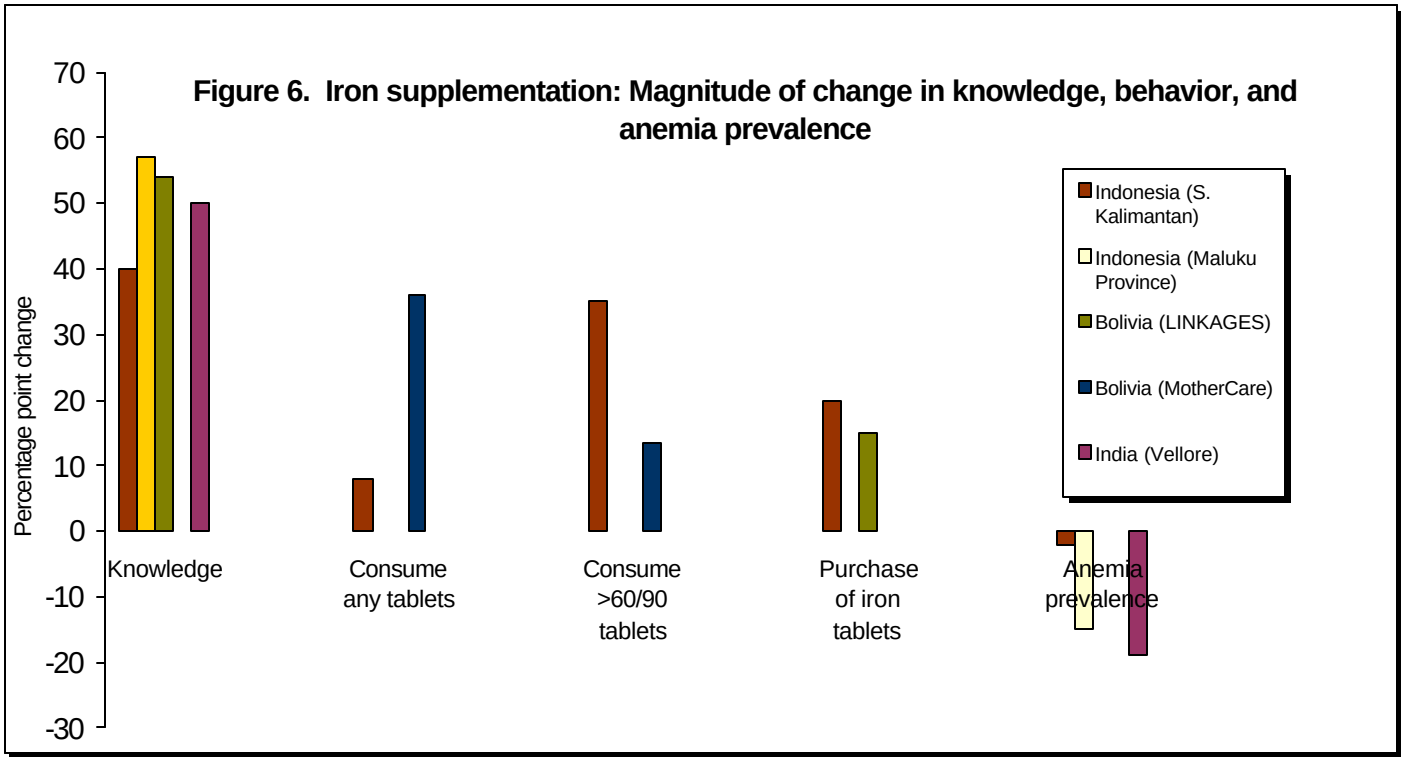
In addition, there is need of an adequate supply of educational materials on iron deficiency and anemia for counseling and dissemination to clients, and possibly synergistic education efforts in the community (e.g., radio broadcasts, village drama). Particularly with a commodity-based intervention such as iron supplementation, changing individual women's and service providers' behavior without addressing the supply system dooms a program to failure.

6. Have projects documented successful behavior change in iron supplementation programs?

The desired magnitude of behavior change is often unrealistic in public health programs. A goal for adoption of a new behavior may be set as high as a 60 to 80 percent increase in the target population. By contrast, the commercial market sector is content with a 3- to 5-percent gain in market share[2]. If we assume that a minimum of 10 percentage points of positive

change in specific behaviors represents significant change, it is possible to conclude that there is demonstrable success in addressing maternal iron deficiency and anemia prevention and control (at least in the short term) through both the public and private sectors.

Illustrative impact results for acquisition of knowledge about iron deficiency and anemia during pregnancy by women, as well as quantification of the magnitude of change for several key behavioral outcomes of anemia control/prevention interventions, are presented in Figure 6 and Table 2 in the Appendix. Not surprisingly, increasing knowledge is accomplished more easily than changing behavior.



7. What are the most critical "adjunct" actions that should accompany traditional diet-based and micronutrient supplement intervention strategies for reducing and/or preventing iron deficiency and anemia among pregnant women and their infants?

Most anemia among pregnant women is due to inadequate intake of bioavailable dietary iron. However, recent hospital-based research in Blantyre, Malawi, found that almost 20% of the anemic women had no deficiencies of iron, vitamin B-12, folate, or vitamin A. It is hypothesized that chronic inflammatory disease (e.g., urinary tract infections, sexually transmitted diseases and tuberculosis) may be contributing to the anemia among these women (van den Broek and Letsky, 2000). In many other settings, malaria and hookworm infections are two leading contributors to anemia, and identification and treatment of these conditions are priority interventions for decreasing anemia incidence and severity among pregnant women.

Malaria

In high transmission areas, pregnant women, and particularly primiparous women, are at increased risk of *Plasmodium falciparum* malaria infection. And babies born to women with malaria are at increased risk of low birthweight (due to both premature delivery and intrauterine growth retardation) (Phillips-Howard, 1999). In areas with endemic malaria, the destruction of red blood cells (hemolysis) and the disrupted process of red cell production due to malarial infection may contribute more to maternal anemia prevalence than dietary determinants.

In the past, WHO recommended full antimalarial treatment of pregnant women at their first antenatal contact, followed by regular chemoprophylaxis. However, drug resistance combined with economic and logistical barriers, have resulted in a need to seek different approaches to the problem (Meek, Robb, and Shulman, 1998). Research in Kenya and Malawi point to the potential for intermittent presumptive treatment of pregnant women after the first trimester of pregnancy with sulfadoxine/pyrimethamine (SP) in areas with high risk of *P. falciparum* infection, chloroquine resistance and SP sensitivity. In Kenya (Schulman et al, 1999) found lower prevalence of anemia, including severe anemia (Hb<8g/dl) among primigravid women treated with SP in their second and third trimesters. A study in Malawi (Verhoeff et al, 1998) documented reduced incidence of LBW using the intermittent treatment protocol. Depending on the malaria endemicity and drug resistance in a specific setting, chemoprophylaxis and treatment regimens will vary.

Concerns regarding the possibility that consumption of iron supplements might increase the incidence and severity of malarial infection have created problems for iron supplementation programs in some malaria-endemic areas. A recent review of existing evidence from 13 placebo-controlled, randomized trials of iron supplementation in malarious areas (2 of the 13 trials targeted pregnant women) concludes that:

- the increased risk of malaria morbidity due to iron supplementation is negligible; and

- the benefits of iron appear to outweigh the risks associated with increased malaria incidence as a result of ingesting iron (INACG, 1999).

Iron supplements for pregnant women should (and usually do) include folic acid. However, consumption of folic acid was noted to reduce the efficacy of SP among a population of children with acute P. falciparum malaria (van Hensbroek et al, 1995). One possible solution to the negative interaction is to forgo the iron/folate supplement on the day women receive the SP treatment.

Helminths

Hookworms are estimated to infect 1 billion people worldwide, including approximately 44 million pregnant women. Prevalence rates range from 10% to 20% in dry areas to 80% in rural areas in the wet, humid tropics. Blood loss due to hookworms feeding on the intestinal mucosa is proportional to the number of adult worms in the gut. In areas of endemic hookworm infection, infection is common in pregnant and lactating women. For pregnant

women, the iron costs of a moderate intensity hookworm infection can **exceed** those of the pregnancy (Table 1).

Table 1: Iron losses and requirements for a typical woman

Source	**Iron Cost (mg/day)**
Basal requirement	0.72
Menstruation	0.44
Pregnancy	2.14
Lactation	0.23
Hookworm infection (moderate intensity) *N. americanus* *A. duodenale*	 1.10 2.30
Other parasitic infections *T. trichiura* (moderate intensity) *S. haematobium* (severe infection)	 0.16 2.10

(Stoltzfus, et al, 1997)

From an analysis of studies in Zanzibar (non-pregnant women) and Nepal (pregnant women), it is estimated that the eradication of hookworm in the study populations can prevent from 19% to 29% of total iron deficiency anemia and from 41% to 56% of moderate to severe anemia. Therefore, reduction of hookworm burdens will contribute to at least a modest decrease in anemia prevalence, particularly of moderate to severe anemia (Stoltzfus et al, 1997). The authors note that the impact from deworming alone could be compared to that of a food-based iron fortification program -- improvement is incremental, and generally small in the first year of the program. However, when anthelminthic treatment is combined with iron/folate supplementation in the antenatal period, results from a 1994 study in Sri Lanka (Atukorala, et al.) demonstrated that the combined treatment is more effective at improving women's iron status and raising hemoglobin concentrations during pregnancy than iron/folate supplementation in isolation.

In areas of endemic hookworm (20 to 30 prevalence) treatment[3] should be given once in the second trimester of gestation. If the area is highly endemic (>50% prevalence), treatment should be repeated once in the third trimester.

8. Clinical evidence supports the fact that women with severe anemia are at greater risk of death due to hemorrhage during delivery and the immediate postpartum period. Why waste resources on universal iron supplementation programs instead of targeting severely anemic women?

Women with severe anemia (hemoglobin (Hb) concentration below 7 g/dl; very severe anemia is categorized as Hb less than 5 g/dl) should be detected and treated. Severely anemic women are at significantly increased risk of death during the perinatal period and severe anemia in the mother has the greatest negative impact on the fetus (UNICEF/UNU/WHO/MI, 1998; Viteri, 1994; Yip, 1994).

However, in populations with high levels of severe anemia[4], nearly every woman is suffering from varying degrees of iron deficiency and/or mild or moderate anemia. Pursuing a program of universal, and not targeted, iron supplementation for pregnant/lactating women addresses the broad spectrum of negative consequences experienced by women suffering from all levels of anemia. Among these are the woman's decreased capacity for work (including the care and stimulation of children), increased potential for absorption of heavy metals by iron deficient women, fetal growth retardation and low birthweight, premature delivery, increased perinatal mortality, and reduced immunocompetence of both mother and baby.

Even in highly developed nations, universal iron supplementation is recommended at a national policymaking level. The Centers For Disease Control's (1998) support of universal iron supplementation of pregnant women is based on the fact that "…a large proportion of women have difficulty maintaining iron stores during pregnancy and are at risk for anemia, iron deficiency anemia during pregnancy is associated with adverse outcomes, and supplementation during pregnancy is not associated with important health risks." In addition to the physiological rationale for universal iron supplementation, the operational realities of lesser-developed countries preclude the feasibility of routine biochemical screening of women for anemia. In settings where the maternal mortality ratio (MMR) and severe anemia prevalence rates are high, screening is usually too expensive and laboratory supplies/personnel are frequently unavailable even if women are able to access health care services.

Because those populations with high MMR and high severe maternal anemia prevalence also tend to have low utilization of antenatal care through the formal health services system, universal (versus targeted) supplementation of pregnant women with iron is essential. Iron/folate tablets should be dispensed in adequate amounts to account for the likelihood that women will only access antenatal care services once or twice before delivery. And in order to locate women with severe anemia, health workers should be trained to perform clinical screening for pallor whenever they have contact with pregnant and postpartum women (Dusch, 1999) in order to support treatment and follow-up of the condition.

9. Reaching pregnant women with health and nutrition interventions is already a difficult undertaking. Why should iron supplementation programs expand their target population to adolescent girls? Are there any models for programs that have successfully addressed this population?

Approaching the problem of poor iron nutrition from an expanded life cycle framework makes sense for a number of reasons. While adolescent anemia data are relatively scarce, a recent study found that anemia was the most prevalent nutrition problem for adolescents in six countries, irrespective of gender (Kurz and Johnson-Welch, 1994). The World Health Organization estimates that 46% of the world's 5-14 year old girls are anemic; even in the U.S., 8- to10-percent of girls (12-19 years) suffer from anemia (National Health and Nutrition Examination Survey '88-'94(NHANES)). Within the MotherCare applied research projects, adolescent anemia prevalence rates ranged from 90% (non-school going girls) in Haryana, India, to 20% among low-income girls in Lima, Peru. The competing demands of increased iron needs due to growth, the onset of menses and (potentially) the additional iron requirements of pregnancy, place the adolescent girl in a high-risk category for compromised iron stores. Overlapping growth and development needs also create a limited period of time in which to acquire iron stores sufficient for a first pregnancy.

For the well-being of the adolescent (emotional, cognitive, and physical growth and development), correcting and preventing iron deficiency and anemia is critical. In addition, there is a substantial body of evidence that suggests that improving the nutrition status of the woman prior to conception is of significant importance to fetal and infant health, and provides a window of opportunity for intervention that cannot be recovered during pregnancy. The periconceptual period is crucial for reducing the risk of occurrence of several nutrient-related conditions in infants (e.g., neural tube defects), and intervention after the first trimester has past is too late.

Yet, the majority of all pregnancies (e.g., >50% in the U.S.) are unplanned, leading to delayed care-seeking in the second and third trimesters (Grimes, 1986). In many countries, unplanned pregnancy during adolescence occurs with even higher incidence (e.g., an estimated 95% of U.S. teen pregnancies are an unintended event) (CDC, 1995). The anticipated benefits of periconceptual iron/folate supplementation include decreased risk of premature delivery, intrauterine growth retardation, and low birthweight, improved fetal and maternal micronutrient status, and decreased risk of fetal morbidity and mortality.

Applied research supported by MotherCare demonstrated that adolescents are open to new ideas and information about their own health and nutrition, and amenable to nutrition-related behavior change. In Peru, adolescent participants in community kitchens increased their intake of heme and non-heme iron sources, as well as improved their consumption of iron absorption enhancers such as lemons to a level significantly higher than adult study participants. Hematological impact data indicated that their improved dietary consumption of iron-rich and iron absorption-enhancing foods protected them from an increased anemia prevalence rate seen in the control groups of the study (Creed-Kanashiro, et al, 2000).

In Gujarat, India, compliance among adolescents participating in a school-based education and supplement distribution program was high (90% of the 200 study participants consumed >94% of the tablets). When school faculty could not provide the requisite administrative/managerial support for the program, adolescents enthusiastically stepped in and took over tasks such as record-keeping for the supplement distribution activity. Side effects from either daily or intermittent iron supplement regimens were minimal and only a minority of girls stopped taking the tablets because of them. Girls were aware of improved energy levels and voiced a desire to continue taking the tablets after the end of the study period.

To maximize the impact on pregnancy and birth outcomes, it is necessary to target adolescents with nutrition interventions as close to conception as possible. In settings where adolescent girls are underweight, anemic, and still growing, implement iron supplement and deworming programs in the schools or other locus points for the target population.

10. What are outstanding issues/challenges to the effectiveness of iron supplementation programs?

Behavior change at the policymaking level remains a challenge. There is a continuing need to generate interest in what remains the world's most prevalent micronutrient deficiency

disease. A lack of concern for the condition and political will to take action to address the determinants of iron deficiency and anemia remain as serious constraints to change.

It is imperative that policymakers and program planners gain an appreciation of the need to vigorously address the problem and approach the design and implementation of supplementation programs with a will to make them succeed, much like those responsible for the control of tuberculosis. Women must be enabled to obtain and comfortably consume iron supplements for the recommended duration during pregnancy, with effort and resources appropriated to reach those unable to take advantage of a well-functioning supply and distribution system.

11. What types of questions remain on the research agenda for the future?

Efficacy trials of new formulations of multimicronutrient supplements are needed to determine if the currently recommended lower levels of iron and folate are adequate to meet the needs of pregnant and lactating women. There is also a continuing need to pursue clinical research to determine the efficacy of additional nutrients for positive impacts on maternal and fetal/infant outcomes. For example, research on calcium supplementation of pregnant women has not yielded uniform results. A persistent, unanswered question concerns the differential impact that calcium may have on hypertensive disorders of pregnancy when delivered to populations suffering from low intake of dietary calcium. The potential for reducing maternal morbidity and mortality through low-dose vitamin A supplement consumption during pregnancy; clarifying the roles of zinc, selenium, magnesium, and other micronutrients during women's reproductive years; and improving a health system's ability to deliver micronutrient supplements to women remain on the research agenda for the future.

Operational research is needed to refine current efforts and define new approaches to implementing the range of known, effective strategies for preventing and controlling iron deficiency and anemia. Finally, it will be critical to push for the scaling up of small-scale efforts in order to make significant headway in addressing the problem.

Endnotes

1. References include Zucker et al, 1994; Van den Broeck et al, 1993; Harrison, 1985; Lllewellyn-Jones, 1965; ACC/SCN, 1991; Edgerton, 1981; Basta et al, 1979; Viteri and Torun, 1974; Scholz et al, 1997; Mola et al, 1999; Scholl et al, 1992; Murphy et al, 1986; Garn et al, 1981; Zhou et al, 1998; Hemminki and Rimpela, 1991; Scholl et al, 1992; Milman 1994; Fel and Lozoff, 1996; Agarwal et al, 1991.

2. Personal comments by Dr. Martin Fishbein at the MotherCare Project/CHANGE Project/WHO Consultative Forum on Behavior Change, Washington, D.C., June, 2000.

3.Albendazole*	400 mg single dose
Mebendazole*	500 mg single dose or 100 mg twice daily for 3 days
Levamisole	2.5 mg/kg single dose, best if a second dose is repeated on next 2 consecutive days
Pyrantel	10 mg/kg single dose, best if dose is repeated on next 2 consecutive days

*The benzimidazoles are broad-spectrum anthelminthics, increasingly used for individual and community-wide treatment of hookworm. They are effective at reducing the intensity of the infection and partially reduce the prevalence (Stoltzfus and Dreyfuss, 1998).

4. According to the International Nutritional Anemia Consultative Group iron supplementation guidelines, >2% of pregnant women is the cut-off for identification of an area with a significant public health problem (Stoltzfus and Dreyfuss, 1998)

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Appendix

Table A1: Priority nutrition programming for maternal and infant health		
Strategy	**Intervention**	**Rationale/Impact**
Improved iron and folic acid nutrition status	♦ Ensure universal daily supplementation of pregnant women with iron/folic acid (60 mg/400 μg) from the earliest possible time in pregnancy for a total of 180 tablets/pregnancy (Stoltzfus and Dreyfuss, 1998). ♦ Continue daily supplementation through 3 months postpartum in areas where maternal anemia prevalence exceeds 40%. ♦ Identify cases of severe anemia and treat/refer to treatment. ♦ Treat pregnant women for helminth infections. ♦ Give intermittent presumptive malaria treatment to primigravid women in areas with endemic malaria. ♦ Inform/counsel pregnant women to plan for exclusive breastfeeding; assist with immediate initiation of breastfeeding at delivery; support exclusive breastfeeding during postpartum period. ♦ Reach adolescents and women **prior** to conception with iron/folate supplements. Inform about/support dietary strategies for increased intake of bioavailable iron/folate.	***Prevention/control of iron deficiency and anemia***: Improved oxygen-carrying capacity/hemoglobin levels of women leading to increased productive capacity/improved well-being; diminished risk of maternal mortality due to severe anemia; decreased incidence of low birthweight, premature delivery, and stillbirths; and improved childhood cognitive/behavioral development. ***Neural tube defect (NTD) risk reduction during peri-conceptual period***: Substantial risk reduction of a subsequent NTD-affected infant among women with prior NTD-affected pregnancy; reduction in first-time NTD-affected pregnancies. ***Prevention/control of folic acid deficiency***: Reduced incidence of folate deficiency-induced anemia.
Iodine fortification	♦ Inform/counsel women to correct/prevent iodine deficiency through consistent, exclusive household use of fortified salt.	Reduction/eradication of goiter, apathy, and lethargy due to iodine deficiency disorders (IDD); increased productive capacity among women. Diminished/eradicated fetal neurological damage leading to nervous system disorders and impaired cognitive function in children, cretinism, stillbirths,

Table A1: Priority nutrition programming for maternal and infant health		
Strategy	**Intervention**	**Rationale/Impact**
		miscarriages, and early neonatal deaths caused by IDD.
Vitamin A supplementation	♦ Administer vitamin A capsules (200,000 IU) to postpartum women within 6-8 weeks of delivery.	Diminished risk/incidence of maternal night blindness and other eye damage, improved maternal and infant immunocompetence, improved maternal hemoglobin response to iron supplementation, decreased incidence of infant morbidity/mortality.
Improved energy balance and dietary intake of protein and micronutrients	♦ Provide information and suggest strategies to help women consume adequate amounts of energy and micronutrients to meet daily needs during pregnancy and lactation: -modify/diversify diet; -assess and modify culture-based food and dietary taboos/detrimental practices; -support positive dietary practices; -reduce workload; and -seek care for/prevent infections.	Improved productive capacity (including child care-giving) of women, reduced intrauterine growth retardation and low birth weight babies, decreased risk/severity of maternal and child morbidity and lower risk of maternal/infant/child mortality.
Smoking reduction/cessation	♦ Provide information and strategies to help women stop/reduce smoking.	Decreased incidence of low birthweight babies (Gulmezoglu et al, 1997); decreased incidence of tobacco-related morbidity and mortality among women.

Table A2: Examples from iron supplementation programs: magnitude of change in knowledge, behavior, and anemia prevalence

Country	Knowledge and counseling behavior	Consume any iron tablets; dietary intake of iron	Purchase iron tablets	Consuming [3] 60 or 90 tablets	Anemia prevalence	Results		
						Baseline	Post survey	Change (% points)
Indonesia, S.Kalimantan Pregnant women 1996/1999 (MotherCare)[1]	Knowledge of action to treat anemia ("Get iron tablets")					1.9%	41.6%	40 (p<.05)
		Pregnant women during pregnancy[2]				65.0%	73.1%	8 (p<.05)
			Obtained through private sector			0%	20%	20
				Pregnant women		8.3%%	43.5%	35 (p<.05)
					Pregnant women Hb<11 g/dL	45.8%	43.6%	-2
Indonesia, S.Kalimantan Newly wed women pilot study 7/98-8/98 (MotherCare)[3]	Knowledge: Ever heard of iron tablets					(n=344) 36%	(n=261) 100%	64
	Received counseling on anemia from religious affairs official					0%	52.7%	53
		Consumed iron tablets daily for 30 days				0%	56%	56
					Non-pregnant women Hb<12 g/dL	23.8%	14.0%	-10

[1] Report on the Anemia Prevention and Control Component in the MotherCare Project, S. Kalimantan, Indonesia, and August 2000.
[2] Comparison baseline/post survey data from MotherCare/Indonesia Final Meeting presentation by Idrus Jus'at, March 2000, Indonesia.
[3] I Jus'at, et al. Reaching Young Indonesian Women through Marriage Registries: An Innovative Approach for Anemia Control. Journal of Nutrition 130: 456S-458S, 2000.

Table A2: Examples from iron supplementation programs: magnitude of change in knowledge, behavior, and anemia prevalence								
Country	**Knowledge and counseling behavior**	**Consume any iron tablets; dietary intake of iron**	**Purchase iron tablets**	**Consuming [3] 60 or 90 tablets**	**Anemia prevalence**	**Results**		
						Baseline	**Post survey**	**Change (% points)**
Indonesia, Maluku Province Pregnant women 1996-1997 (Project Concern International)[4]	Knowledge of specific symptom of anemia (dizziness) Knowledge of specific intervention to prevent anemia (iron supplements)					(n=200) 59% 26% 29.2%	(n=200) 93% 82% 14.6%	 34 56 (p<.02) -15
					Pregnant women Hb<11 g/dL			
Bolivia (LINKAGES) Non-pregnant women, Santa Cruz 7/99 – 12/99[5]	Knowledge of multivitamin supplement, *Vitaldia* (prompted/unprompted)		Purchase of *Vitaldia*			0% 0%	54%/88% 15%	54/88 15
Bolivia 1996/1999 (MotherCare)[6]		Pregnant women consume 30 tablets				26.2% 6.0%	62.1% 19.5%	36 13.5
				Pregnant women consume ≥90 tablets				

[4] S. Robinson. Working with Traditional Birth Attendants to Improve Iron Tablet Utilization by Pregnant Women: Maluku Province, Indonesia. MotherCare Technical Working Paper#8, Arlington, VA. September 1998.
[5] S. Huffman. Presentation at the MotherCare/CHANGE/WHO Behavior Change Consultative Forum, June 2000.
[6] MotherCare/Bolivia. Caminos de intervencion sustentable en salud. La Paz, Bolivia, 2000.

Table A2: Examples from iron supplementation programs: magnitude of change in knowledge, behavior, and anemia prevalence								
Country	**Knowledge and counseling behavior**	**Consume any iron tablets; dietary intake of iron**	**Purchase iron tablets**	**Consuming [3] 60 or 90 tablets**	**Anemia prevalence**	**Results**		
						Baseline	**Post survey**	**Change (% points)**
Vellore, S.India[7] Pregnant women and non-pregnant adolescent girls 1996-1998 Rural Unit for Health and Social Affairs (RUHSA), Christian Medical College and Hospital	Knowledge (adolescents) of iron supplements as prevention of anemia					0% (n=155)	52% (n=238)	52
	Knowledge (pw) of iron supplements as prevention for anemia (intervention vs. control)					40.8% (n=409)	8.8% (n=464)	32 (p<.001)
	Knowledge (pw) of low iron intake as cause of anemia (intervention vs control)					95.4% (n=409)	45.3% (n=464)	50 (p<.001)
				Pregnant women consuming ≥ 60 tablets/preg		23.4% (n=522)	37.2% (n=409)	13.8
					Pregnant women Hb<11g/dL	70.3% (n=464)	50.4% (n=403)	-18.9 (p<.001)

[7] R. Abel, J. Rajaratnam, and V. Sampathkumar. Anemia in Pregnancy: Impact of Iron, Deworming, and IEC. RUHSA Department, Christian Medical College and Hospital, Vellore District, Tamil Nadu, India, 1999.

Table A2: Examples from iron supplementation programs: magnitude of change in knowledge, behavior, and anemia prevalence								
Country	**Knowledge and counseling behavior**	**Consume any iron tablets; dietary intake of iron**	**Purchase iron tablets**	**Consuming [3] 60 or 90 tablets**	**Anemia prevalence**	**Results**		
						Baseline	**Post survey**	**Change (% points)**
Peru Non-pregnant women and adolescent girls participating in community kitchens, peri-urban Lima 1996-1997 (Instituto de Investigacion Nutricional)[8]	Knowledge (intervention vs. control) of adolescent girls regarding dietary iron absorption enhancers	% Recommended daily requirement of dietary iron, (FAO/WHO, 1989) • Adult women • Adolescent girls				100% (n=71) 53% (n=96) 48% (n=71)	19% (n=65) 71% (n=77) 59% (n=65)	81 18 11

[8] H. Creed-Kanashiro, et al. An Intervention to Improve Dietary Iron Intake among Women and Adolescents through Community Kitchens in Lima, Peru: Final Report. MotherCare/JSI, Arlington, VA. 1998.